DOCUMENT RESUME

ED 291 575 SE 048 907

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TITLE Strategies for Developing Critical Thinking in Mathematics.
PUB DATE 16 Nov 87
NOTE 17p.; Inservice Workshop presentation for Green Valley Elementary School (November 16, 1987).
PUB TYPE Guides - Classroom Use - Guides (For Teachers) (052) -- Speeches/Conference Papers (150)

EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS *Childrens Literature; Computation; *Critical Thinking; Elementary Education; *Elementary School Mathematics; Estimation (Mathematics); Geometric Concepts; *Learning Activities; *Mathematics Curriculum; Mathematics Education; *Mathematics Instruction; Measurement; Number Concepts; Probability

ABSTRACT

This document suggests sources from children's literature useful in teaching a variety of mathematical concepts. The mathematical concepts discussed are: (1) numbers and numeration; (2) place value; (3) shapes; (4) addition and subtraction; (5) multiplication and division; (6) telling time; (7) probability, estimation and prediction; (8) fractions and decimals; (9) measurement; and (10) money. Discussion of each concept includes the identification and description of a primary resource, activities, extensions, and other resource books. (PK)

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STRATEGIES FOR DEVELOPING CRITICAL THINKING IN MATHETMATICS

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Inservice Workshop Presentation for

Green Valley Elementary

3:00 Monday, November 16, 1987

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SE 048 907

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CONCEPT ONE: NUMBERS AND NUMERATION

Book: Anno's Counting Book by Mitsumasa Anno (Harper & Row, 1977)

At first glance, this is a book which wordlessly shows the building of a village. It starts with zero and builds to twelve. On each spread there are sets of things: people, trees, buildings and vehicles demonstrating each number. The number is also shown by building blocks at the left side of the page and by the numeral at the right side of the page. As you look more carefully, you can see that the clock in the village church shows a time corresponding to the number being demonstrated. It usually takes several looks before you discover that the seasons are being shown as each number depicts the month of the year.

ACTIVITIES: As you examine the book with the children, have them keep track of the sets by using a graph with the numerals along the vertical and the names of the sets along the top of the graph. Other classifications, such as living and non-living sets, can also be graphed.

Make a classroom mural with panels marked off the way Anno divides the book, but have the children build an urban scene this time, using sets seen around the city instead of Anno's country setting.

Have the children make sets of figures and items for the flannel board to correspond to the numbers from one to twelve. Let the children take turns setting the task by putting either the numeral, squares denoting the number, or sets which show the number on the flannel board. The rest of the class completes the flannel board picture.

Other concepts and extensions: The book can be used to practice telling time by the hour by looking at the church clock in the pictures.

Writing a story in which the village and villagers are named, and the reasons for each building's existence are given, will extend the book into the language arts program as well.

RESOURCE BOOKS

Anno - Anno's Mysterious Multiplying Jar (Philomel, 1983).

Anno - Anno's Counting House (Philomel, 1982).

Arnosky - Mouse Numbers and Letters (Harcourt, 1982).

Baum - One Bright Monday Morning (Random House, 1962).

Blegvad - One Is For The Sun (Harcourt, 1968).

Carle - The Very Hungry Caterpillar (Philomel, 1969).

Carle - The Rooster Who Set Out to See the World (Watts, 1972).

Chwast - Still Another Number Book (McGraw-Hill).

Cleveland - April Rabbits (Coward, 1978).

Clifton - Everett Anderson's 1,2,3 (Holt, 1977).

Cohen - Three Yellow Dogs (Greenwillow, 1986).

Crews - Bicycle Race (Greenwillow, 1985).

Ernst - Up to Ten and Down Again (Lothrop, 1986).

Feelings - Moja Means One (Dial, 1971).

Hutchins - One Hunter (Greenwillow, 1982).

McLeon - One Snail and Me (Little, Brown, 1961).

McMillan - Counting Wildflowers (Lothrop, 1986).

Ormerod - 101 Things to Do with a Baby (Lothrop, 1984).

Oxenbury - Helen Oxenbury's Numbers of Things (Watts, 1983).

Reiss - Numbers (Bradbury, 1971).

Seuss - The Five Hundred Hats of Bartholomew Cubbins (Vanguard, 1938).

Wildsmith - Brian Wildsmith's 1,2,3's (Watts, 1965).

Standard of Learning

K-2 The student will identify the number of items and the corresponding numeral, giving a set having 0 to 10 members. Concrete objects will be used. With reference to numerals, the intent is to identify not write.

CONCEPT TWO: PLACE VALUE

Book: The Five Hundred Hats of Bartholomew Cubbins by Dr. Seuss (Vanguard, 1938)

This children's classic has poor Bartholomew Cubbins trying madly to take off his hat before a tyrant king while new hats keep appearing on his head. At times, Bartholomew counts his hats and you have sections of numbers in sequence. We know what Bartholomew and the king do not, that Bartholomew will reach five hundred hats before the senseless magic stops.

ACTIVITIES: Make three paper hats of three different colors which are similar to Bartholomew's hats. Label them 100's, 10's and 1's. Make feathers of three different sizes and colors corresponding to the hats. Have the children make lists of the numbers which Bartholomew counts aloud in the book and then place the feathers in the correct hats to indicate one of the numbers on their lists. After the number is shown, the class checks off that number on their lists.

Later, take away the color and then the size clues to make all the feathers the same. Other hats can be added to show thousand, ten thousand and hundred thousand if the tale is extended.

Other concepts and extensions: To practice number writing and estimation skills, make a large construction paper or newspaper hat which will sit on a child's head. Have the children write a number in words or numerals which predicts how many feathers can be carefully placed on the hat before it tips over.

To practice rounding off numbers, give each child a paper hat. Put the numbers from the story on the chalkboard. The children print rounded-off numbers on their hats and place the hats near the appropriate number on the board.

You can approach fractions by asking the children to tell what fraction of five hundred hats Bartholomew is up to at various points in the book. Adding and subtracting the number of hats from the five hundred is also a possibility.

Tell the children that the collected hats are to be donated to a museum. Have them use division skills to tell how many cases with how many shelves in each case can be used to house the hats. Make the display cases.

RESOURCE BOOKS

Estes - The Hundred Dress (Harcourt, 1974).

Gag - Millions of Cats (Coward, 1928).

Mathis - The Hundred Penny Box (Viking, 1975).

Roy - A Thousand Pails of Water (Knopf, 1978).

Ormerod - 101 Things to Do with a Baby (Lothrop, 1984).

Standard of Learning

1.2 The student will identify the place value of each digit in a two-digit numeral.

CONCEPT THREE: SHAPES

Book: Brian Wildsmith's 1,2,3's by Brian Wildsmith (Watts, 1965)

There is no story in this book, only the numeral, the number word and Wildsmith's beautifully colored geometric figures to demonstrate the numbers. Of course he shows much more than the number. There are shapes within shapes and colors jumping about the pages. We found the book more useful for its shape concepts than for its stated purpose.

ACTIVITIES: Make a segmented bulletin board with sets labeled triangles, squares, rectangles, rhomboids; and subsets labeled red, orange, yellow, blue, purple. Using tracing paper isolate and trace over shapes from the figures in the book. Transfer the shapes to colored oaktag roughly corresponding to the colors in the book. Give each child one of the shapes to locate in the book. When the child locates the shape, he or she places the shape on the bulletin board in a set and subset that is appropriate.

Let the children construct other figures made of shapes such as those in the book. Make the assignments progressively harder. For example: construct a figure made of triangles; construct circular shapes using non-circular shapes.

Other concepts and extensions: To give children practice in finding perimeter measurements, have each child first estimate and then find the perimeter of any of the figures in the book. The child then challenges classmates to guess which figure he or she chose.

The children can also find line segments, lines of symmetry, and perpendicular lines.

RESOURCE BOOKS

Carle - The Secret Birthday Message (Harper, 1972).

Emberley - The Wing on a Flea (Little, 1961).

Ungerer - Snail, Where Are You? (Harper, 1962).

Ungerer - One, Two, Where's My Shoe (Harper, 1964).

Standard of Learning

1.16 The student will identify triangles, squares, and rectangles. Models and pictures of the geometric figures will be used.

CONCEPT FOUR: ADDITION AND SUBTRACTION

Book: Anno's Counting House by Mitsumasa Anno (Philomel, 1982)

This is a simpler book than Anno's Counting Book, which we used in the first concept. In this book, ten children who are shown in a cut-away of the inside of a house are going to move, one at a time, to a house on the other side of the street, also shown in a cut-away. Each time a child moves, he or she takes something along for the new house. Windows of the houses are cut out and, at various times, some of the occupants of either house can be seen through the windows. In this manner, the number ten is broken down into many of its components.

ACTIVITIES: Use sheets of mural paper on which to print all of the equations shown in the story. As two children hold up the equations, let other students group themselves around the numerals to make live equations from a page of the book.

Make simple drawings of the children in the book. Move the drawn figures back and forth between flannel board houses as combinations of ten are made with numbers.

Let the children devise word problems for the actions in the book. When a child reads his or her word problem aloud, let the other children figure out which page in the book is being described.

Other concepts and extensions: Concentrate on classifying the various figures shown in the book. For example: how many boys, girls and figures wear a given color. Graph the classifications. Look for triangles, squares and rectangles in the illustrations. Use position words to describe the placements of the various figures. Name the children in the book and write a story to tell about the move.

RESOURCE BOOKS

Mahy - The Boy Who Was Followed Home (Dial, 1975).

Carle - The Very Hungry Caterpillar (Philomel, 1969).

Elkin - The Six Foolish Fishermen (Scholastic).

Also, most of the books listed for the concept of numeration.

Standard of Learning

2.7 The student will find the sum of two or three whole numbers, each 9 or less.

2.9 The student will find the difference given a subtraction problem related to the basic addition facts through 9 plus 9.

CONCEPT FIVE: MULTIPLICATION AND DIVISION

Book: In this case, we're not going to use one special book, but will ask you and the children to assemble all fairy tale and other books which have the number three or multiples of three in their titles and/or have plots in which the number three figures prominently.

ACTIVITIES: Let each child devise a graph or chart which will best organize information from the books as to their use of three. It could show the titles on the vertical with categories across the top, for example, people, places, deeds, items and animals. Any set-up is accepted as long as it allows for the organization of the information. Use these charts to obtain total figures for categories by employing multiplication skills.

Use division skills in the following manner: Ask the children to make up new titles involving as many items as possible from one category. For instance, if it were "The Four Little Pigs" instead of the usual three, is there a figure on the charts which would be evenly divisible by four so that each of the characters in the new story could have one of the items? How about "The Five Little Pigs"? etc. If you remove the qualification "evenly" from the assignment above, what remainders would you have?

Other concepts and extensions: Find items in stories which contain prefixes showing numbers: triangles, bifocals, octopuses, pentagons, etc. Find out the reasons folklorists give for the prevalence of three in folk tales. Make large triangles on paper and let the children write or retell a tale containing threes in the triangle.

RESOURCE BOOKS

Anno - Anno's Mysterious Multiplying Jar (Philomel, 1983).

Anno - Socrates and the Three Little Pigs (Philomel, 1986).

Cleveland - April Rabbits (Coward, 1978).

Dubanevich - Pigs in Hiding (Four Winds, 1983).

Kennedy - Contests of Cowlick (Little, 1975).

Lobel - A Treeful of Pigs (Greenwillow, 1979).

Slobodkina - Caps for Sale (Addison, 1947).

Standard of Learning

4.7 The student will find the product of two whole numbers involving basic facts through 9 X 9.

4.9 The student will find the quotient given a division problem involving the basic facts through 81 ÷ 9.

CONCEPT SIX: TELLING TIME

Book: All in a Day by Eric Carle et al (Philomel, 1986)

We deliberately by-passed many picture books which involve time on a simple level to go to a difficult book using advanced concepts of time in order to show that picture books can be used at upper grade levels as well as the lower grades to accent math concepts. Using works by many illustrators, this book demonstrates the concept of time around the world. The first page, for instance, shows a moment which is December 31 at 6 p.m., and 10 p.m., January 1 at 10 p.m., 3 a.m., 9 a.m., 8 a.m., 11 a.m., and 12 noon in various parts of the world. In each place, children are going about their lives, doing what they would do at that particular time of day. The plot, as such, revolves around a shipwrecked person radioing an SOS, but is unable to get anyone's attention.

ACTIVITIES: Mark one side of the room to show the various time zones in the United States. Later, use the entire room to show the time zones around the world. Use clock faces to show the time in each zone at a given moment. Let children set the clocks and pantomime appropriate actions at the various times of day. The book gives the time by means of a twenty-four hour clock so bring in a twenty-four hour clock such as is used on many video-tape recorders or military clocks. Have the children set a conventional alarm clock to go off when the twenty-four hour clock shows a given time. Figure out the time it would take to fly to an area of the world; then make mock airplane tickets, showing arrival times in various time zones. Make word problems involving time and the book: if Kae-Kae is eating supper at 5 p.m. in Beijing, China on January 1st, how many hours away is supper for Ben of Australia?

Other concepts and extensions: Investigate and give oral reports on Greenwich mean time and the international date line. Translate some of the times shown by using Roman numerals. Find out about the means of communication Oliver Smith uses in the book. Which ones would be most successful? What conditions would have to be present for some of his SOS messages to be received?

RESOURCE BOOKS

Barrett - Benjamin's 365 Birthdays (Atheneum, 1978).

Burton - Mike Mulligan and His Steam Shovel (Houghton, 1939).

Carle - Grouchy Ladybug (Harper, 1977).

Clifton - Everett Anderson's Year (Holt, 1974).

Harvey - My Prairie Year (Holiday, 1986).

Sendak - Chicken Soup with Rice (Harper, 1962).

Shulevitz - One Monday Morning (Scribner, 1967).

Viorst - Sunday Morning (Atheneum, 1968).

Standard of Learning

1.14 The student will tell time to the hour.

CONCEPT SEVEN: PROBABILITY, ESTIMATION AND PREDICTION

Book: Who Sank the Boat? by Pamela Allen (Coward, 1982)

Five friends -- a cow, a donkey, a sheep, a pig and a mouse -- decide to go for a rowboat ride. As each creature enters the boat to near disaster, the question is asked, "Do you know who sank the boat?" The comedy is slapstick. The answer to the question is obvious to any frequent reader, but the book draws readers of many ages back again and again.

ACTIVITIES: Estimate the weight of each creature. Find research to support or discredit your estimates. Find other objects with the same average weight as the creatures in the story. Set up a water table in the classroom and suggest that students bring in toy boats. Record predictions of how many objects can be placed in each floating boat before it sinks.

Build boats of various materials such as clay or foil, and predict which can hold the greatest weight. Change the designs for greater buoyancy. Predict the results. Graph the results of the trials.

Other concepts and extensions: Sequencing is a reading skill as well as a math skill. In math, we use a previous sequence as a basis for predicting the next event. Have the children find more books in which what has already happened is a basis for predicting what happens next. Cumulative tales such as: "The Old Woman Who Swallowed a Fly" are ideal for this activity. Have the children list the possibilities for the next event in a tale with strong sequence, and then list the odds for each possibility being next in the book.

RESOURCE BOOKS

Anno - Socrates and the Three Little Pigs (Philomel, 1986).

Lobel - "Journey" from Mouse Tales (Harper, 1972).

Nozaki & Anno - Anno's Hat Tricks (Philomel, 1985).

Testa - If You Take a Pencil (Dial, 1982).

Ueno - Elephant Buttons (Harper, 1973).

Standard of Learning

5.22 The student will solve word problems involving addition, subtraction, multiplication and division of whole numbers.

CONCEPT EIGHT: FRACTIONS AND DECIMALS

Book: Moon Man by Tomi Ungerer (Harper, 1967)

The Moon Man comes to earth in hopes of relieving his loneliness, but finds only prejudice. Eventually, he is put in prison. Fortunately, like the moon, the Moon Man has phases. Waiting until his first quarter phase, he slips through the bars of the prison and gets back to the sky by means of a rocket ship.

ACTIVITIES: Make a phase line (like a number line) for the moon with: 0/4, 1/4, 2/4, 3/4 and 4/4. Have the child cut out moon shapes to place on the phases of the moon.

Write fractions and/or decimals on cards. Provide each child with an outline shape of Moon Man (or have the child draw the outline). Shuffle the cards and place them face down on a table. The child selects a card, and then fills in as much of the Moon Man outline as directed by the fraction or decimal on the card.

Take photos of the moon or examine photos and artists' renditions of the moon. Estimate its fractional size. State the ratio as a decimal and as a fraction.

Imagine that in outer space there are other, as yet undiscovered, planets with shapes other than spherical -- for example, triangular, square or rectangular. These planets have phases in some other proportion than quarters. Have each child name, draw and label the phases of one of these strange planets.

Suppose that other objects besides the moon appeared in phases. What phases would buildings such as the school take on? Make charts and posters showing the phases of various buildings and places.

Other concepts and extensions: Moon Man gets back into the sky in a rocket ship. Research the distance between earth and moon and calculate the speed the ship must achieve to reach the moon in a given number of days or hours.

RESOURCE BOOKS

Anno - Anno's Counting Book (Harper, 1977).

Anno - Anno's Counting House (Philomel, 1982).

Wildsmith - Puzzles (Watts, 1970).

Wildsmith - Brian Wildsmith's 1,2,3's (Watts, 1965).

Standard of Learning

4.11 The student will read and write decimals expressed as tenths.

6.12 The student will add with fractions and mixed numerals where the sum of the fractional parts is less than one.

CONCEPT NINE: MEASUREMENT

Book: Jim and the Beanstalk by Raymond Briggs (Coward, 1970)

The giant from "Jack in the Beanstalk" is still up there. This time, a boy named Jim finds a giant beanstalk growing near his house. Climbing the beanstalk, Jim finds the giant grown old and unable to see or eat because of failing eyesight and no teeth. Taking careful measurements of the necessary parts of a giant's body, Jim goes back to earth to purchase (using giant gold pieces) false teeth, eye glasses and a wig.

ACTIVITIES: Assemble as many measuring devices as possible: tapes, rulers, metersticks, callipers, yardsticks. Have the children measure their heads and mouths for glasses and teeth. Let them multiply those figures by the appropriate figures to make the articles giant-sized. What other items can they think of for the giant? What sizes would those articles have to be? Make charts showing the people-sized and giant-sized statistics. Make something to scale that he might use.

Find out the weight of a U.S. gold coin. Use the ratios on the chart to find out what the weight of the giant's coins might be. Use a balance scale to find a material with the same weight as the giant's coin.

Get into liquid and solid measurement through recipes. Find a recipe for meat pie in a cookbook. Multiply the ingredients so that the pie would satisfy a giant's appetite.

Find books with other giant-sized characters -- for example, Finn McCool and Zeralda's Ogre (Harper, 1967). Figure the dimensions of objects mentioned in those books.

Find recipes for foods mentioned in other books: Blueberry Pie from Blueberries for Sal (Viking, 1948), Blueberry Pie Elf (Parents, 1950) or A Chocolate Moose for Dinner (Messner, 1976).

Other concepts and extensions: Map out the directions so that the giant can locate you in your home or school, remembering that the giant must use giant-sized landmarks. Write sequels to other fairy tales.

RESOURCE BOOKS

Baumann - The Hare's Race (Morrow, 1976).

Kellogg - Island of the Skog (Dial, 1973).

Kellogg - Much Bigger Than Martin (Dial, 1976).

Lionni - Inch by Inch (Astor-Honor, 1963).

Steig - Abel's Island (Farrar, 1976).

Williams - Three Days on a River in a Red Canoe (Greenwillow, 1981).

Standard of Learning

3.10 The student will measure length in inches, feet, and yards.

CONCEPT TEN: MONEY

Book: Alexander Who Used to Be Rich Last Sunday by Judith Viorst (Atheneum, 1978)

Alexander has great plans for the money he has on Sunday. Unfortunately, as the days of the week pass, so does his money -- from his hands into the hands of those who have things Alexander wants.

ACTIVITIES: Give the children coins or play coins to represent the money Alexander has at the beginning of the story. Let one or two children use the board to record and subtract the money Alexander spends while the others push the coins from one side of their desks to the other.

Give children forms to set up and keep track of a bank account for Alexander. As he spends each amount, they record the transactions on their bank account sheets.

Keep a money diary of the story as you read with columns labeled: "Spent," "Purchased," and "Balance" or "Debit," "Credit" and "Net," depending on the age of the children.

Use real coins to have the children figure out the amounts Alexander spends. Have the children calculate the fewest coins possible, the most coins possible, mostly nickels, and so on.

Set up a store with items priced so that the children can purchase many items with the amount Alexander has at the beginning of the story. Give the children cards stating: "You must buy five items for the amount Alexander has" or "You must buy ten items," etc.

Use the same store set-up with amounts won in a game patterned after a currently popular television game show.

Have the children make up word problems such as: "Alexander has $4.63. If he buys four items for a total of $3.00, how much money does he have left?"

Other concepts and extensions: If Alexander did not spend his money, but instead banked it at 7 percent interest, how many years would it take for him to have over $100?

RESOURCE BOOKS

Aleichem - Hannukah Money (Greenwillow, 1978).

Mathis - The Hundred Penny Box (Viking, 1975).

Standard of Learning

3.12 The student will determine by counting the value of a collection of coins (pennies, nickels, dimes, quarters, and half-dollars) whose total is one dollar or less.